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Two new records and one confirmation of the genus *Poa* L. (Poaceae) for the Flora of Turkey

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Abstract: The ongoing revision of the genus *Poa* in Turkey has resulted in two new *Poa* records for the Flora of Turkey as *Poa pratensis* subsp. *irrigata* (Lindm.) H. Lindb. and *Poa eigii* Feinbrun. In addition, the presence of *Poa palustris* L. is confirmed. A brief discussion and an illustration for each taxon are provided.

Key words: *Poa*, Poaceae, new records, confirmation, revision, Turkey

1. Introduction

Poa L. (Salkımotu, Cabi and Doğan, 2012) is the type genus of the grass family Poaceae Barnhart. It comprises over 550 species distributed in temperate regions of the world. Extensive polyploidy, hybridization, apomixis, and only a few useful morphological characters make the genus taxonomically difficult (Gillespie and Soreng, 2005).

In the Flora of Turkey, Edmondson (1985) reported 24 species. He noted one imperfectly known species as *P. hackelii* Post, and two doubtful species as *P. iberica* Fisch & C. A. Mey and *P. palustris* L. In his treatment, he placed *P. eigii* Feinbrun under *P. bulbosa* L. s.l. In subsequent years, three more *Poa* species, *P. akmanii* Soreng, P.Hein & H.Scholz, *P. asiae-minoris* H.Scholz & Byfield, and *P. bussmannii* H. Scholz, were described from Turkey. In the checklist of the Poaceae of Turkey, Cabi and Doğan (2012) reported 30 taxa, including *P. densa* Troitsky, and the three questionably present taxa *P. palustris*, *P. iberica*, and *P. hackelii*.

The objective of the current study is to report the presence of three unreported or uncertain taxa of *Poa* from Turkey.

2. Materials and methods

The authors carried out extensive fieldwork between 2011 and 2014 and collected a large number of specimens of the genus *Poa* for the purpose of revising the genus in Turkey. Upon closer examination of these materials and going through the Flora of Turkey (Edmondson, 1985) and other relevant floras (such as Flora Europaea (Edmondson, 1980), Flora Orientalis (Boissier, 1884), Flora of Syria, Palestine and Sinai (Post, 1933), Flora of Iraq (Bor, 1968), Flora Iranica (Bor, 1970), and Grasses of the Soviet Union (Tzvelev, 1983)), the taxa included in this study were recorded for the first time or verified for Turkey. Our *Poa* specimens were compared with materials housed at various European (E, G, K, P) and Turkish herbaria (ANK, AEF, KNYA, ISTE). Herbarium acronyms follow Holmgren and Holmgren (1998). All authors of plant names follow Brummitt and Powell (1992).

3. Results and discussion

3.1. *Poa* subgen. *Poa* sect. Poa

3.1.1. *Poa pratensis* subsp. *irrigata* (Lindm.) H. Lindb. Sched. Pl. Finl. Exs. 2: 20. 1916 (Figure 1)

Basionym. *Poa irrigata* Lindm., Bot. Not. 1905: 73, 88 1905, nom. superfl., Type: Sweden: Uppsala, "Upsaliae", leg. Ehrhart. (LE) equals ~*P. humilis*~ Ehrh., nom. nud.

Homotypic Syn. *Poa humilis* Ehrh. ex Hoffm., Deutschl. Fl. 1: 45. 1800, Type: Sweden, Uppsala, Ehrhart 115 (isotypes: LE! plant B on sheet, plant A on sheet is *P. pratensis* subsp. *alpigena*, LE! [2 sheets] plant B ex E. Fries Herb. Normal, LE-TRIN-2598.02! plant B ex E. Fries Herb. Normal).

Heterotypic Syn. *Poa bourgeaei* E. Fourn. Mexic. Pl. 2: 113 1886. Type: Mexico, Distrito Federal, pres San Angel, 23 May 1865, E. Bourgeau 225 (isotype: US-89690! fragm.). *Poa subcaerulea* Sm., Engl. Bot. t. 1004 1802. Type: UK: England: Great Britain Wales, Borth, Leg. Hubbard CE, 1453 (K, K000641178)

Perennial, strongly rhizomatous, tufts sparse or dense to loose, sometimes forming turf, or some or all shoots

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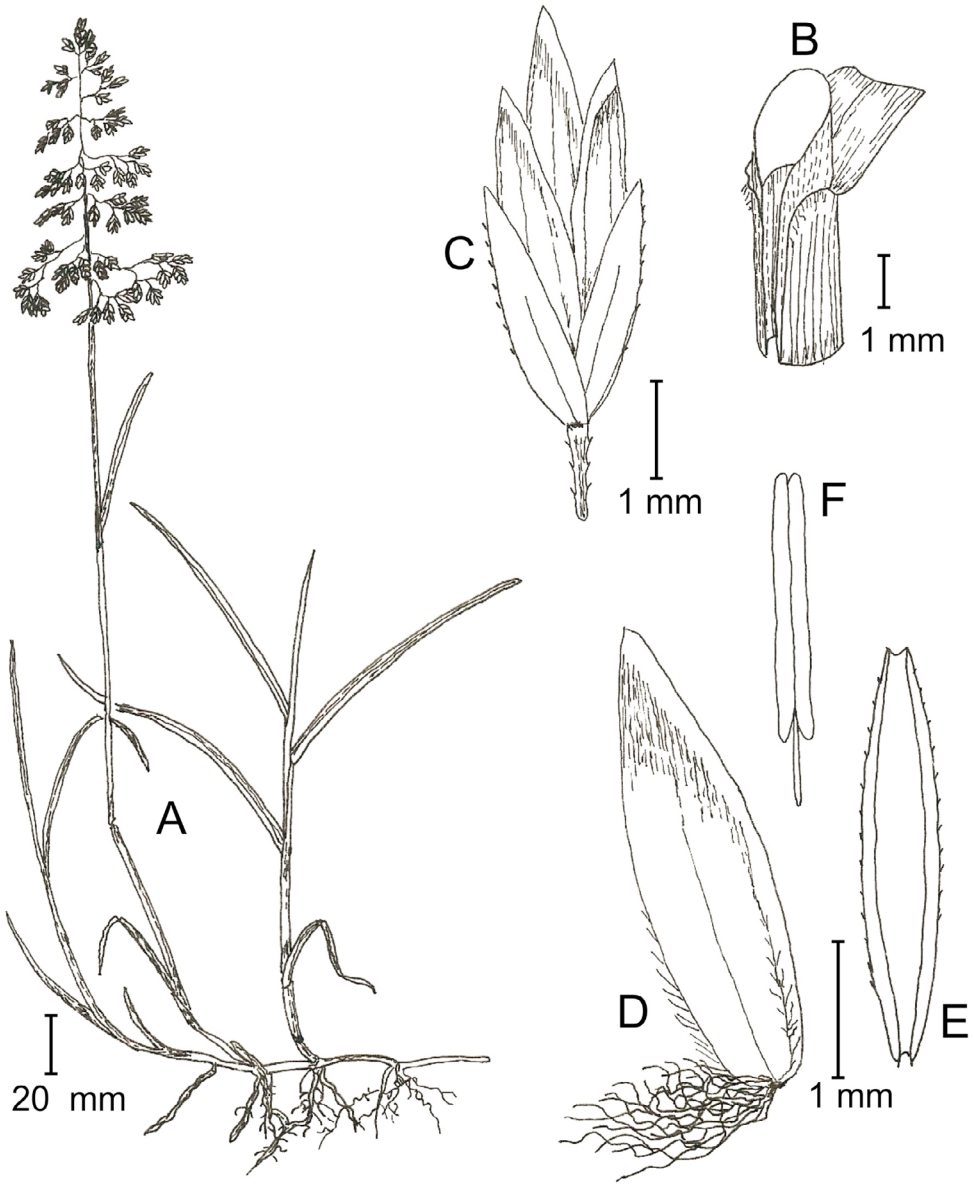

Figure 1. *Poa pratensis* subsp. *irrigata*: A. Habit; B. Spikelet; C. Ligule and sheath lateral view; D. Floret; E. Anther; F. Palea.

solitary; dark green, or bluish gray green; tillers all or mainly extravaginal. Culms 8–30(–50) cm tall; collar margins commonly retrosely strigulose. Ligules of lower culm and tiller leaves commonly pubescent abaxially; blades of cauline leaves flat, thin, soft; sterile shoots blade usually less than 15 cm long, 2–4.5 mm wide, usually glabrous adaxilly. Panicles 2-10 cm long, open, broadly pyramidal; rachis with 1–3(–5) branches per node; primary branches widely spreading, smooth or sparsely to moderately scabrous; longest branches 1.5–6 cm with 4–8 spikelets. Spikelets lanceolate to broadly lanceolate, not viviparous; glumes subequal, often glaucous; lower glumes (1–)3-veined; upper glumes usually subequalling the lowest lemma; callus with a well-developed tuft of dorsal wool; lemmas 3–6 mm long, keel and marginal veins villous, surfaces between veins finely muriculate, intermediate veins distinct, glabrous; paleas scabrous, medially glabrous over the keels, intercostal region glabrous.

Habitat: Moist meadows, riparian vegetation, disturbed ground, often seeded in lawns and pastures. The subspecies is tolerant of many substrates.

Distribution: Turkey; Outside Turkey: The subspecies occurs all across Eurasia, and is considered to be introduced in North America (Canada, Greenland, USA,

and Mexico- Veracruz) but may be native in some parts of North America.

Discussion: The subspecies is often cultivated for pastures and lawns. Cultivated forms selected for lawns with soft leaves and loose tufts have generally been referred to as *Poa pratensis* subsp. *irrigata*, considered Eurasian in origin. Although *P. pratensis* subsp. *angustifolia* and subsp. *pratensis* are clearly indigenous to Turkey, we cannot confirm whether the subsp. *irrigata* is native or introduced here. Although at least at one locality it appeared to be part of the native flora, it is probably also introduced from commercial seed sources and dispersed from such introductions. *Poa pratensis* and many other *Poa* species possess a tuft of wooly hairs at the base of the florets (on the dorsal side of the callus) that readily entangle in fur and feathers of animals and aid in dispersal (Soreng and Peterson, 2012).

Some authors suggest that *P. pratensis* subsp. *latifolia* (Weihe ex Mert. & W. D.J. Koch) Schübl. & G. Martens and *P. pratensis* subsp. *irrigata* are conspecific and the former is the correct name (Portal, 2005). At the species rank, this subspecies is called *P. humilis* Ehrh. ex Hoffm. and *P. subcaerulea* Sm. *Poa pratensis* is possibly the world's most complex species, fascinating in itself, but of which we know much too little. It varies in chromosome numbers from $2n$ = 27 up to ca. 147, with almost every number in between represented. It is also facultatively apomictic (Clausen, 1961).

Key to the subspecies

1. Plants with fascicles intravaginal shoots with narrow, involute, thickish, fairly firm, blades, that are sparsely strigose adaxially, in addition to narrow lateral shoots at tips of rhizomes; panicles elliptical to narrowly ovoid, with small spikelets; plants usually of xeric or submesic habitats ..... ***Poa pratensis* subsp. *angustifolia***

1. Plants with or without fascicles of intravaginal shoots; if with them, the fascicles sparse, and the blades fairly thin, soft, adaxially usually glabrous, in addition to lateral shoots at the tips of rhizomes with broader leaves; panicles narrowly ovoid to pyramidal, with small or large spikelets: plants often of moist to wet habitats.

2. Glumes subequal, frequently pruinose, lower glumes 1 (–3)-veined, similar in shape to the upper glume, upper glumes often equal to the lowest lemma in length; panicles fairly or sparsely flowered, collar margins and ligule abaxial surfaces commonly pubescent; all or most vegetative shoots extravaginal, emerging from rhizome buds and tips and isolated from the flowering culms; blades mostly all similar in form, flat or folded, 1.5–3.5 (–5) mm wide; panicle branches 2–5; plants of mesic to wet habitats .... ***Poa pratensis* subsp. *irrigata***

2. Glumes unequal, infrequently pruinose, lower glumes 1(–3)-veined, narrower than the upper glume, upper glumes usually shorter than the lowest lemma in length; panicles fairly moderately or densely flowered; collar margins and ligule of abaxial surfaces usually glabrous; some intravaginal shoots present in addition to extravaginal shoots of the above form, the intravaginal shoots usually with narrower, involute blades, blades often different in form, flat or folded, and involute, the involute blades 0.5–1.5 mm wide; panicle branches mostly 5; plants of many habitats ..... ***Poa pratensis* subsp. *pratensis***

Poa pratensis subsp. *angustifolia* (L.) Gaudin is more drought tolerant than the other two subspecies known from Turkey. It is most easily recognized by its dense fascicles of very fine, relatively firm, involute leaf blades that adaxially generally exhibit sparse strigose hairs (subsp. pratensis blades are usually glabrous). According to Stoneberg-Holt (2004), subsp. *angustifolia* is a lower polyploid ($2n$ = 28 to 42 but up to 56?), and many of the higher counts are reported in the literature for this taxon (at least those above $2n$ = 56 are possibly referable to subsp. *pratensis* and subsp. *irrigate*).

Specimens studied: A2(A) Bursa Uludağ, 1659 m, under *Abies* and *Carpinus* sp., 24 Jun 2014 E. Cabi s.n. (NAKU); **B2 Kütahya** Simav, Simav mount. around summit, clearings and under *Pinus nigra* forest, E. Cabi, F. Celep s.n. (NAKU, US); **B4 Ankara**, METU Campus, around Tennis court, 2 Jun 2007, E. Cabi s.n. (NAKU).

3.2. Poa subgen. Stenopoa (Dumort.) Soreng & L.J. Gillespie sect. Stenopoa Dumort.

3.2.1. *Poa palustris* L. Syst. Nat. ed. 10, 2: 874. 1759 (Figure 2)

LT: (LINN-87.21) LT designated by Soreng in Cafferty & al. (ed.), Taxon 49: 256 (2000)

Heterotypic Syn: *Aira poiformis* Willd. ex Steud., Nomencl. Bot. ed. 2, 1: 45 1840, Type: Mexico, Humboldt, A. von, s.n. (Herb. Berolinense B -W01863-010). *Poa adspersa* Drejer, Fl. Excurs. Hafn. 35 1838, Type: Sweden: In graminosis umbrosis I. Grosterne ved Veien til Charlottenlund, Sep 1836-1837. *Poa crocata* Michx., Fl. Bor.-Amer. 1: 68 1803, Type: Canada, Quebec, juxta amnes ad lacus Mistassinos affluentes indeque ad sinum Hudsonis defluentes, leg. Michaux, no. 160 (P). *Poa fertilis* Host, Icon. Descr. Gram. Austriac. 3: 10 1809, Type: Europe, *sine loco.*,leg. Host,N.T., s.n. s.d.(W, W0029756!) *Poa volhynensis* Klokov, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 12: 48 1950 Type: Ukraine, Volyn, Korabeloneo forestry, pine forests, large swamps, (LE).

Rather loosely tufted. Vegetative shoots mostly extravaginal, sometimes with aerial shoots arising from the lower culm sheaths. Stems (15–) 40–80 cm, smooth. Upper culm sheaths open for 1/5 or more of their length. Leaf-blades 1–2 (–3) mm wide; flat, thin, margins smooth or weakly scabrid, culm blades erect to steeply ascending,

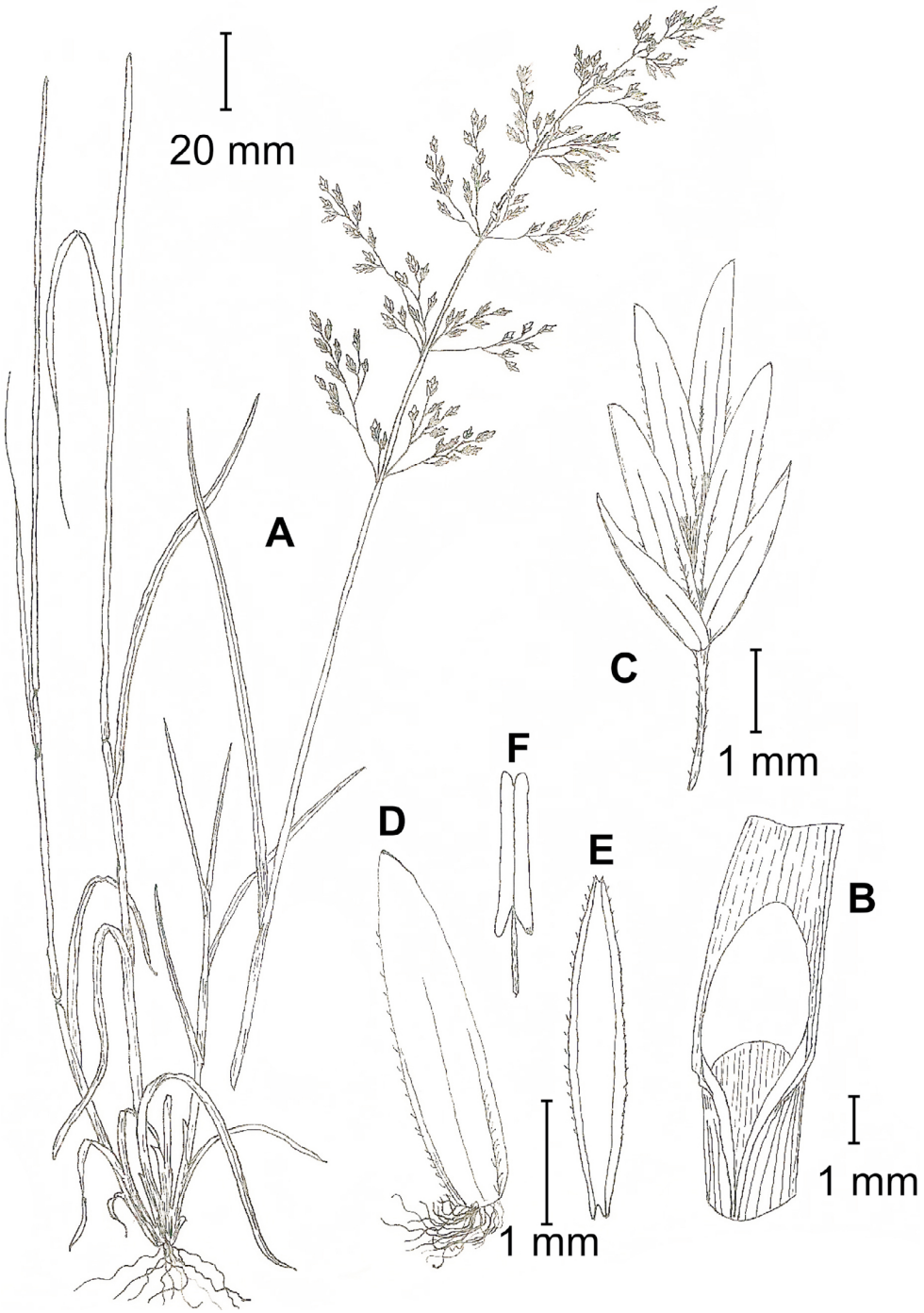

Figure 2. *Poa palustris*: A. Habit; B. Ligule and sheath lateral view; C. Spikelet; D. Lemma; E. Palea; F. Anther.

somewhat lax. Ligule (1-) 1.5-3.5 mm, obtuse to acute. Panicle 8–12 cm, lax, pyramidal; branches scabrid, 2–5 at lower nodes, widely ascending to patent, bearing spikelets only on the upper part of each branch, commonly with many spikelets but sparse with few spikelets in depauperate specimens. Spikelets 3–5 mm, with 2–3 (–5) florets; glumes subequal; rachilla internodes, minutely bumpy or hispidulous; lemma short hairy on keel and marginal veins, glabrous between the veins, intermediate veins faint, apices commonly briefly incurved, with a narrow, bronzy colored scarious-hyaline tip; callus of lemma with a long tuft of sparse hairs.

Habitat: Wet meadows, streamsides, sometimes under *Salix*. igneous substrates.

Distribution: Turkey: **B9 Ağrı**, It appears to be native in eastern Turkey. Outside Turkey: Eurasia and North America, widespread.

Discussion: *Poa palustris* (bataklık salkımı) is native to Asia, Europe, and northern America. Edmondson (1985) noted an old record of *Poa fertilis* Host (synonym of *Poa palustris*) from **B1 Çanakkale**; Ager Trojanus (Truva), collected by *Schmidt*, is doubtful. In our opinion, the cited location seems an unlikely habitat for the species. In 2014, we found three new localities of the species in eastern Turkey. The species can potentially be confused with *P. nemoralis* L., but can be separated using the characters given in the Table.

Specimens studied: Turkey: B9 Ağrı: Balık Gölü Dere, near outflow dam at SE end of lake, N side of Ağrı Dağı, NW of Taşlıçay ca 19 km. With: *Deschampsia*, *Phragmites*, *Glyceria*, *Poa*, *Lolium*, *Agrostis*. Coordinates: 39.73455° N; 43.58762° E; 2258 m Sandstone valley. Riparian vegetation, on rocks, small islands, and in seeps, R. Soreng, E. Cabi 9001, 5 Aug 2014. (NAKU, US); **Ağrı**: Ca. 6 km N of Taşlıçay (on Hwy 100), just N of Yukari Toklu on road to Balık Gölü with *Salix*, *Epilobium*, *Agrostis*. Coordinates: 39.69537° N, 43.42189° E; 2110 m. Broad shallow sandstone valley with steppe vegetation and cultivated hay fields, riparian strand along shallow stream, with *Salix*. R. Soreng, E. Cabi 9006, 5 Aug 2014 (NAKU, US).

3.3. *Poa* subgen. *Ochlopoa* (Asch. & Graebn.) Hyl. sect. *Arenariae* (Hegetschw.) Stapf (syn. P. sect. Bolbophorum Asch. & Graebn.)

3.3.1. *Poa eigii* Feinbrun, Bull. Misc. Inform. Kew 1940: 280 1941 (Figure 3)

Hermaphroditic. Perennials; primary roots very slender, 0.1–0.2 mm in diameter; without rhizomes or stolons, densely tufted, tufts 1–4 (–5) cm tall, forming extensive mats; dark green; tillers bulbous at the base, intravaginal, bulbs small, prophylls 0.3–0.7 mm long, thin, keels finely scabrous. Culms 10–18 cm tall, erect, or arching, sometimes geniculate, capillary, 0.7–1 mm in diameter, terete, smooth; nodes smooth, 1 (–2) exerted. Leaves mostly basal; leaf sheaths, basal ones compressed, strongly imbricated at base, old sheaths persisting; bulbous, basal-medially thickened with a scarious margin, elongate pyriform in lateral view, at least some distally sparse to dense short scabrid-hispid, hairs ca 0.15 mm long, erect to retrorse, flag leaf sheath 2.4–5.5 cm long, margins fused 15%–22 % of the length, smooth, glabrous; collars of lower leaves sometimes a bit scabrid-hispid; ligules 1–2.5 mm long, scarious, milky-white, abaxially sparsely scabrous, apices acute, of sterile shoots 0.2–1 mm long, not or narrowly decurrent; blades 0.2 (folded)–0.4 mm wide (flat), 0.5–1.2 cm long on the culm, mostly folded with slightly involute margins, abaxially scabrous along the keel and sometimes along some veins, margins scabrid, adaxially smooth, thin, soon withering, obscurely prow tipped, culm blades gradually reduced upward in length; sterile shoot (lateral, bulbous based, not flowering in current year) blades 1–4 (–5) cm long. Panicle 1.5–4 cm long, oblong, compact, with (20–) 30–70 spikelets, peduncles 7–15 cm long, smooth, proximal internodes ca 0.8–1 cm long, (2–) 4–5 branches at the lowest node; primary branches erect to steeply ascending, straight, capillary, terete, smooth or sparsely scabrous, pedicles ca. 1 mm long, longest branches 1–1.6 cm, with (3–) 6–8 spikelets. Spikelets 3–4 mm long, vivipary absent (in this form); florets 3–5, normal in form; rachilla internodes short, mostly less than 0.5 mm, terete, obscurely muriculate, glabrous; glumes, subequal, the upper almost 2× broader than the lower, smooth, apices acute to acuminate; lower glume 1.8–2.8 mm; upper glume 2.3–3 mm; callus glabrous; lemma 2.2–3.2 mm, ovate, 5-nerved, thin papery, light green, strongly keeled, keels and marginal veins crisply long pectinate-ciliate, between veins smooth, muriculate, glabrous, intermediate veins obscure, margins moderately scabrous, narrowly scarious-hyaline, apices acute frequently apiculate; palea keels scabrous in distal 2/3–1/2, between keels muriculate.

Table. Differences between *P. nemoralis* and *P. palustris*.

P. nemoralis	*P. palustris*
Ligule up to 0.5 (–1.0) mm long, apex truncate	Ligule 1–2.5 (–6) mm long, apex obtuse to acute
Culms smooth throughout	Culms scaberulous below the nodes
Culm leaf-blades spreading	Culm leaf-blades erect or laxly ascending
Rachilla shortly pilose	Rachilla bumpy or hispidulous
Lemma apex straight	Lemma apex briefly incurved
Web short, usually less than 1/3 the lemma in length	Web long, ca. = the lemma in length
Not wet	Wet meadows and riparian vegetation

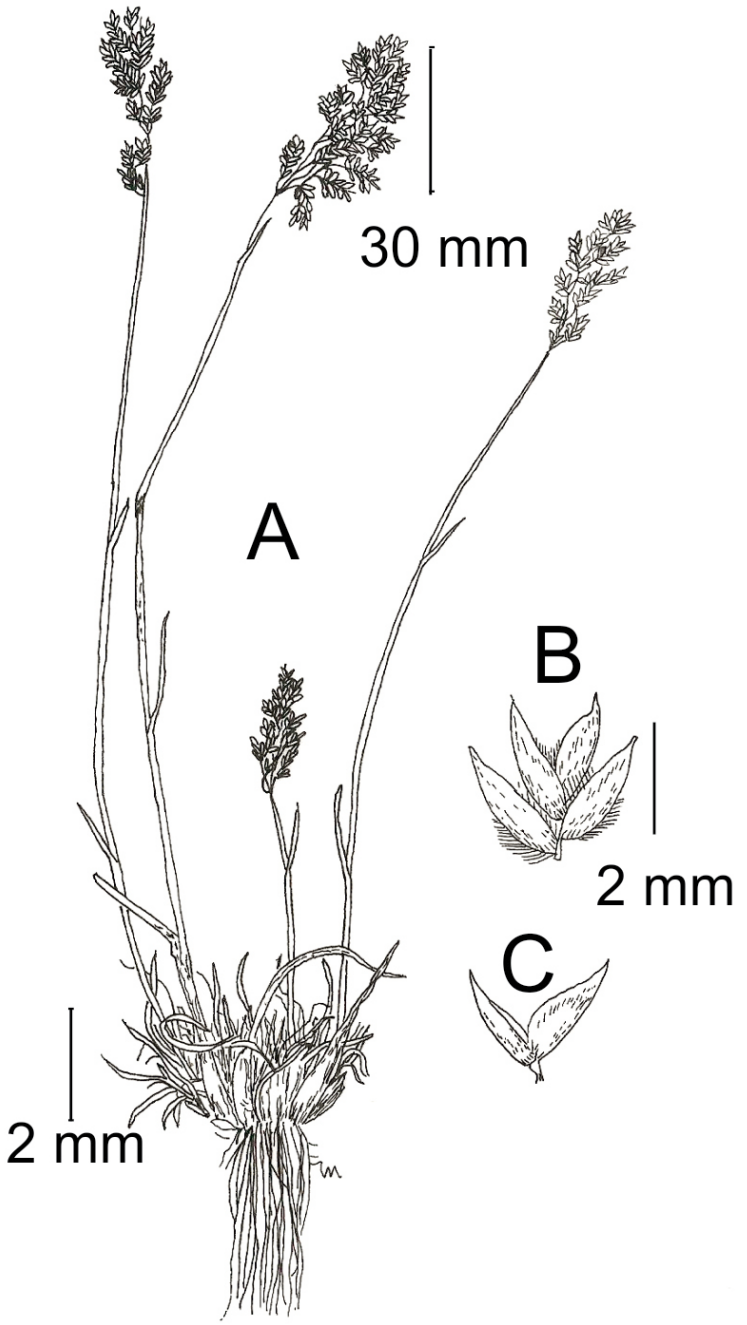

Figure 3. *Poa eigii*: A. Habit; B. Florets; C. Glumes.

Flowers bisexual; anthers 1.2 mm long; caryopsis 1.4 cm long, trigonous, ventrally flat to shallow sulcate, hilum ca 0.2 mm long.

Habitat: High mossy meadows, where fog or clouds are frequent in the spring and winter, near tree line in the coastal mountains. Substrate unknown.

Distribution: Turkey: Aydın; Outside Turkey: Middle East-Jordan, Israel-Palestine.

Discussion: This species fits within *Poa* sect. *Bolbophorum* Asch. et Gr. ser. *Bulbosae* Roshev. (Roshevits and Shishkin, 1934), *P.* subgen. *Poa* sect. *Poa*, subsect. *Bulbosae* V. Jirasek (sensu. Tzvelev, 1983), or P. sect. *Bolbophorum* Asch. & Graebn. (Edmondson, 1980). This bulbous group of *Poa* is now included in *P.* sect. *Arenariae* (see Soreng, 2007). This section, subsection, or series, comprises a complex of species whose sheaths of new

radical leaves are thickened to form small bulbs that are surrounded by tunics of sheaths of preceding years, and they have leaf-blades that usually wither upon desiccation.

Poa eigii differs from *P. bulbosa* chiefly in the lack of a tuft of wool arising from at the base of floret (callus), and in its dense compact tufts forming low "great patches and surfaces". It differs from other elements placed in *Poa bulbosa* s.l. (including *P. bulbosa* and *P. sinaica*), and *P. timoleontis* Heldr. ex Boiss. that have pubescent lemmas by its short ligules on the basal leaves. From *P. hackelii* Post (a poorly understood taxon) it differs with its smaller size and short sheaths of the radical leaves, which are densely covered by residual sheaths. Our plants also differ from the above taxa in that the leaf-blades, sheaths, and culms below the nodes are scabrid to hispidulous.

Specimens studied: C1 Aydın: Aydın Mountains. Along road to the summit from Aydın, near the summit. 37°57'11.3" N, 27°53'53.2" E, 1615m; 20 Jun 2011; Open, calcareous rock, rocky and dry; L. Gillespie, E. Cabi, R. Soreng, and K. Boudko, s.n.(CAN, NAKU, US).

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